MONTHLY JOURNAL OF
THE MUSHROOM GROWERS'
ASSOCIATION

MGA BULLETIN

SEPTEMBER, 1961 · NUMBER 141

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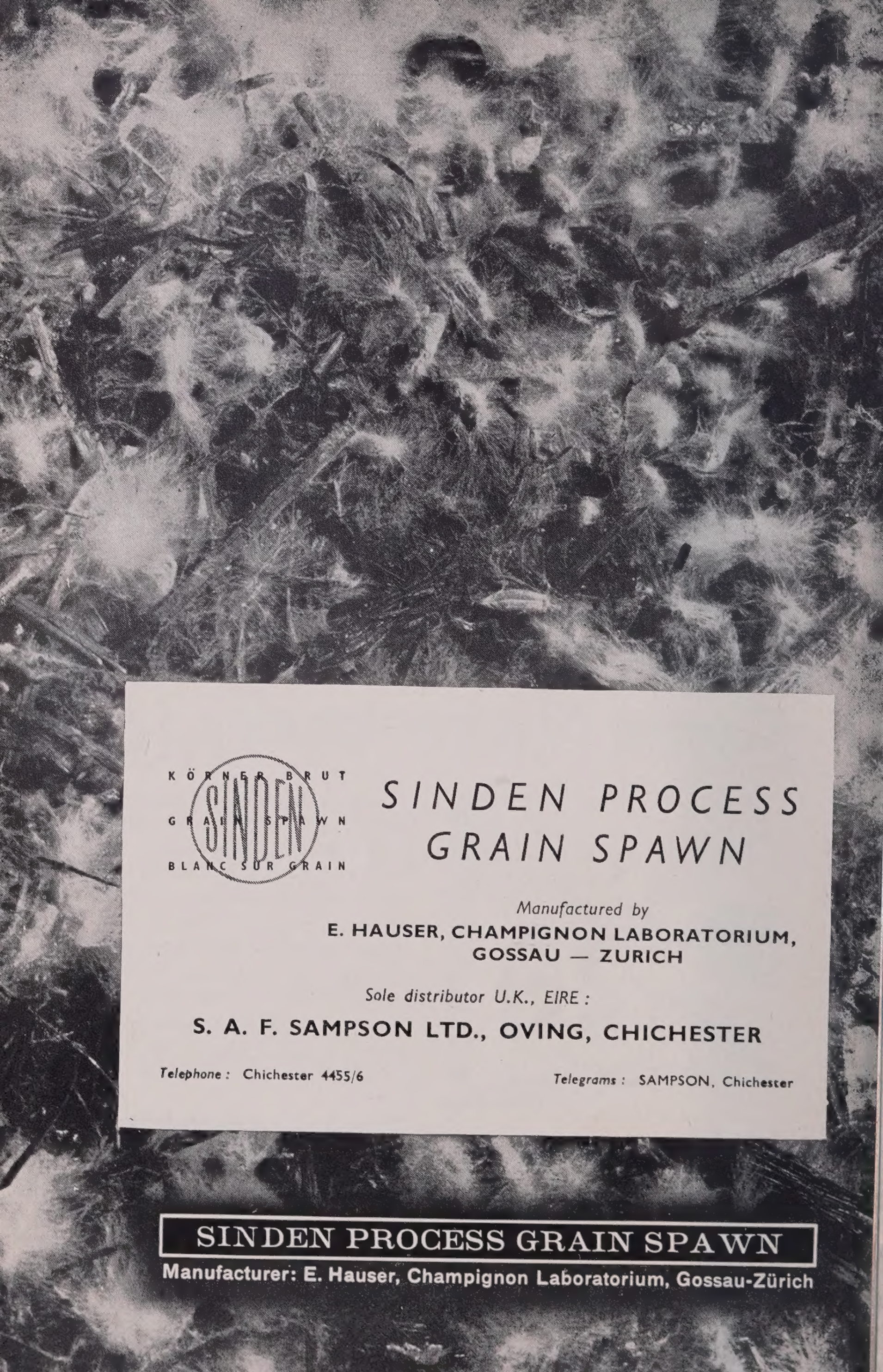
DON'T FORGET YARMOUTH
16 17 & 18 OCTOBER



The
MGA BULLETIN

SEPT. - 1961
NUMBER 141

EDITORIAL

NOW IS THE TIME

Producers of broiler chickens have lately been facing a shattering time, with production, up 35% this year, outstripping demand. The result has been that prices have dropped to as low as 1/3d. per lb. to the producer, 4d. per lb. below what is considered an economic cost of production on large units.

For months and months producers have been warned about the consequences of over-production yet blindly, and it seems without pausing to reason, production has been stepped up and the point reached where a million and a half birds are said to be stock-piled and where some packing stations can take no more.

The foregoing is not designed to spread dismay and despondency amongst mushroom growers, for the state of affairs which exists with the broiler people has no place in the mushroom industry as yet—but it could be so.

For years this editorial has favoured expansion, always provided that such expansion goes hand in hand with increased demand. To date there is no evidence that such expansion has resulted in disastrous prices. Rather are prices now at a more realistic level. With increased publicity—and the need for this becomes more and more evident every day—there is no need to fear the future.

What is now needed is a full and frank discussion on the future of the industry; the preparation of a five year plan at least if not one that looks even farther ahead. In this respect the largeı producers have a particularly important role to fill for it is to them as well as to the MGA that the bulk of growers look for guidance. Such a meeting should be called without delay for time may not necessarily be on our side.

WRA

4,000 SQ. FT. ON SHELVES—AND STILL GOING STRONG

Mr. Knight senior walking from his house (background) past the growing sheds.

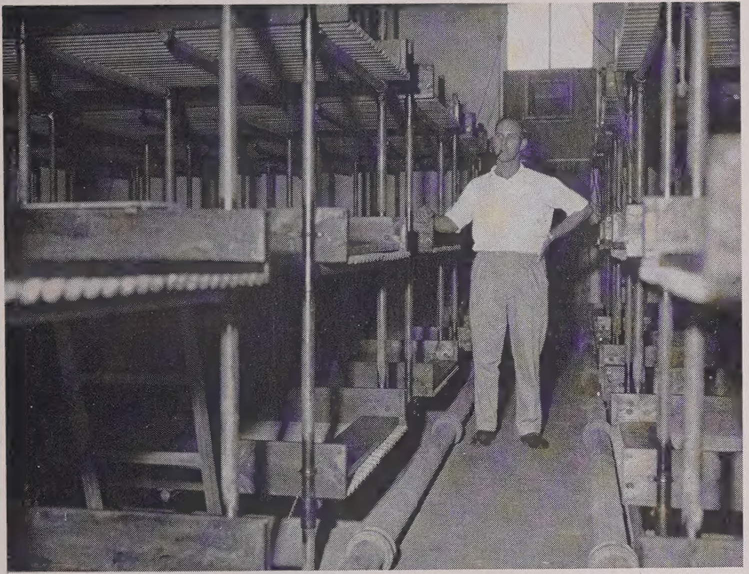
Where stands the small mushroom producer in this age of expansion and efficiency? What chance has he of surviving now that mushroom farms of 50,000 sq. ft. and over are becoming increasingly common? Will he, in fact, be squeezed out by the larger grower?

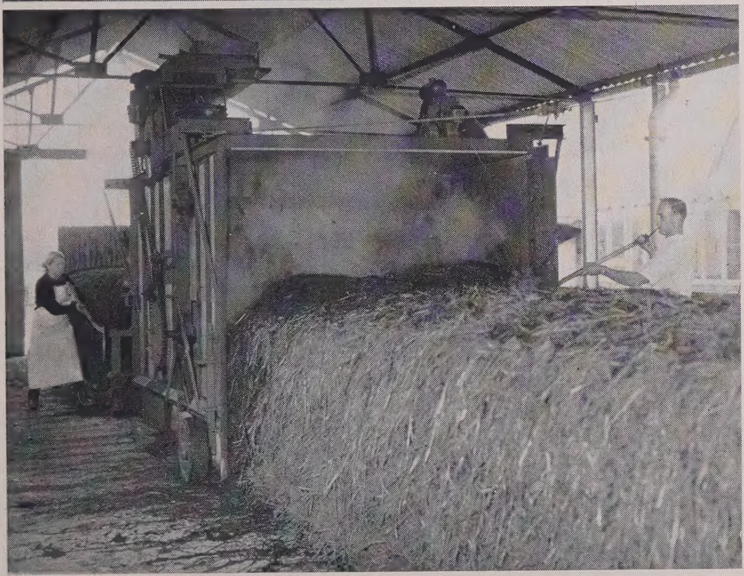
One such small producer is Mr. J. R. Knight of Dukes, Allens Green, Sawbridgeworth, Herts., who, by efficient production on a basic shelf area of just under 4,000 sq. ft., is not particularly worried by larger rivals.

It should be made quite clear from the start that this small mushroom farm, situated as it is alongside the 300 acre farm of Mr. Knight senior, enjoys an advantage in that help for filling is available from a brother-in-law who farms the land.

A view of the composting shed showing (left) one of the polythene, timber-framed screens, used in winter to keep the cold winds out. Life of the polythene, under these conditions, is reckoned at two years.

This farm consists of six buildings, four of which are Romneys and semi-circular, 41′ long × 35′ inside at floor level. Two of these are growing sheds and a third will be in use shortly. Each of these contain 1925 sq. ft. of bed. The fourth is used as a general store. The composting shed is a span-roofed building, 75′ × 25′ inside, totally enclosed on three sides with doors at each end and removable shutters on the fourth side, to enable manure to be unloaded into the building. The sixth is a small cold room.





(TOP): Inside one of the growing sheds, ready for filling. Mr. J. R. Knight has every reason to be pleased with his success.

(BOTTOM): A close-up of the composting machine at work. Note the top mounted engines and the side chains and sprockets. The entire permanent staff of the farm is seen in this picture.


The monkey winch at work pulling the composter.

The composting shed was originally built for long composting by hand turning and for this reason the concrete floor was raised three inches along the centre, so that either of two parallel heaps could be wetted without affecting the other.

"Sinden" composting is now practised with only one pile, 7′ 2″ wide up the centre of the shed. Use of this over-wide heap was dictated by the length of the existing building, this being the only diversion from the pure "Sinden" method. One hundred and twenty yards of racing stable manure with supplements is wetted and stacked by hand between two paint lines running the length of the building, but afterwards all turning is done by an ingenious self-fed machine which is pulled by cable winch into the heap.

The machine, which was designed and built in the farm workshop, comprises a rectangular tunnel-like structure mounted on two fixed and two caster wheels. It uses a large diameter spike drum to pick up the compost, which is then picked off the top of the drum by a rotary device above and deposited in the rear half of the structure, this forming the pile. After a great deal of experimenting, with many bitter disappointments, this turner now makes what the grower feels is a really good "Sinden" compost, in a wide pile. It mixes the compost vertically and crosswise, is powered by a ten-horse Bristol tractor engine and transmission unit and a three HP ex-fire pump engine. Three operators are needed, a lad at the winch and two others behind the machine. Water and/or copper sulphate solution is applied as required through sprays within the machine. The pile is turned in two hours.

Crops are grown on shelves with standard corrugated asbestos bottoms and 7″ deep timber side boards and are built three high on $1\frac{1}{4}$″ galvanized tube support frames. The thirty shelves per shed have an area of 1,925 sq. ft. in the 16,000 cu. ft. shed, giving a high

MEMO

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air to bed ratio, which makes ventilation less critical. Two crops only per shed are taken each year, the average per sq. ft. per crop, without stalks, being $3\frac{3}{4}$ lb., from a crowned 10″ deep bed. The August filling crops for twelve weeks and the winter filling for about sixteen weeks, with a break during the hot weather.

The concrete baths outside each house.

CALYPSO . . .

'SIMULATE' NOT 'STIMULATE'

An error costs a lot if, once perhaps,
A worker has a temporary lapse,
When rushing for selective fungicide
He takes unknowingly formaldehyde
And ruins by a tragic little pour
A crop that's worth a thousand pounds or more!
Or, likewise, take the chef who demonstrates
At shows, to folk who would adorn their plates
With mushrooms found in rings beside a ditch;
To teach the art of knowing which is which,
He rashly eats one cap as light falls dim———
The poisonous———and that is end of him!
Alas! Our best laid plans go all awry,
So often so, however well we try.
The essence of these lines, by undersigned,
Are leading to a climax of a kind—
Our Bulletin, July, on line nineteen,
Prospective Growers' Guide, gives what has been
A type-setter's mistake where *simulate*,
With extra '*t*' inset, reads *stimulate*,
And which, precisely, renders null and void
The wealth those lines had otherwise enjoyed.

FP (BELFAST)

ASK—FOR MUSHROOMS

The GPO and the British Farm Produce Council have collaborated in Birmingham to provide a phone-a-meal service which was started on 26th July. By phoning ASK 8071 Birmingham housewives can get a new recipe which is cheap and seasonable and which uses only British produce. In the first fortnight 21,776 calls were made and among the recipes given out was one for mushrooms devised by our cookery adviser Mrs. March who is now also working for the British Farm Produce Council. Here it is:—

Scotch Mushrooms

Select some good size firm button or cup mushrooms—not opens—and marinade them in French dressing for two hours. Remove excess moisture from the mushrooms with a dry cloth, cover each mushroom with sausage meat, making an oval shape, coat the mushrooms with egg and breadcrumbs and fry in deep fat until golden brown. When cold, cut the mushroom in half lengthwise before serving. They are very good cold with a salad.

DUTCH EXPERIMENTS

A Report by Dr. P. J. Bels from the Dutch Mushroom Research Station in the January/February Dutch Mushroom Bulletin gives details of experiments during 1959 and 1960. Below are two tables and a summary. A translation of the full report is available on loan from the library.

The main object of these experiments was to compare casing materials, and Tables X and XI from the report, reproduced below by kind permission of Dr. Bels, summarise the results obtained.

Apart from yield, quality is important and in Holland good quality means "a compact form with a strong short, rather thick stem and firm cap which stays closed for a long time".

Dr. Bels notes that during the period under review composts were made progressively drier, less water being added per ton of manure, and this change was associated with strong yields (although their general growing technique improved as they gained experience with their new experimental cropping houses).

He found, as others have, a general inverse relation between yield and average size of mushrooms, though where figures for size are given all the mushrooms were small by our standards (6-7 mushrooms per ounce).

The author comments on the small size and poor quality of mushrooms obtained during high yields in a short picking period (e.g., 2 lb. per sq. ft. in five weeks) and suggests that this is achieved by "wet" growing. Better quality in a longer period is obtained by growing "drier", and Dr. Bels intends to investigate this problem further.

TABLE X

Survey of Production with Points Assessment

TABLE III Experiment 5	pH	Kg./M² 13½ Weeks	Points Assessment
Potting Soil (Venlo)	7.8	11.25	100
Loose Peat (Asten)	7.8	11.17	100
Silt (Velden)	7.9	10.62	96
Clay (Afferden)	7.9	8.79	80
TABLE IV Experiment 8	pH	12 Weeks	Points Assessment
Loose Peat (Asten)	7.7	8.72	100
Loose Peat (Asten)+ Clay (Afferden) 1 : 3	7.9	7.82	90
Potting Soil (Venlo)	7.6	7.47	86
TABLE V Experiment 10			
Loose Peat (Asten)	6.7—8.0	10.16	100
Loose Peat (Asten) + Building Sand 2 : 1	7.5	10.12	100
Clay Maasbommel	8.0	9.39	94
TABLE VI Experiment 12	pH	11½ Weeks	Points Assessment
Clay Maasbommel	8.1	5.27	75
Loose Peat (Asten)	8.0	7.24	100
Loose Peat (Asten)+ Clay Massbommel 1 : 1 ..	8.0	5.55	79
TABLE VII Experiment 13	pH	12 Weeks	Points Assessment
Clay Maasbommel	8.2	9.50	86
Loose Peat (Asten)	8.1	11.05	100
Loose Peat (Asten)+ Clay Maasbommel 1 : 1 ..	7.6	10.93	99
Loose Peat (Asten)+Clay Maasbommel 1 : 2 ..	7.6	10.17	92
TABLE VIII Experiment 15	pH	6 Weeks	Points Assessment
Clay (Mook)	8.0	7.89	81
Clay (Mook)+Peat Dust from Bales (Germany) 1 : 1 ..	7.9	9.58	99
Peat Dust from Bales (Germany) ..	7.9	8.41	87
Loose Peat (Asten)	7.9	9.66	100

TABLE XI

Resumé Points Assessment

	Pts. (No. of expts.)	Av. Pts.
Loose Peat (Asten)+Building Sand 2 : 1	100 (6)	100
Loose Peat (Asten)+ Clay Maasbommel 1 : 2.. ..	92 (1)	92
Loose Peat (Asten)+Clay Afferden 1 : 3	90 (1)	90
Loose Peat (Asten)+Clay Maasbommel 1 : 1.. ..	79 & 99 (2)	89
Peat Dust from Bales+Clay Mook 1 : 1	99 (1)	99
Silt (Velden)	96 (1)	96
Potting Soil (Venlo)	100 & 86 (2)	93
Peat Dust from Bales	87 (1)	87
Clay Maasbommel	94, 75 (3) 86	85
Clay Mook	81 (1)	81
Clay Afferden	80 (1)	80

CORRESPONDENCE

THAT WASN'T CORRECT

Refer Bulletin No. 135, "Twenty-Five Years in Mushroom Growing ".

1. The synthetic used was balanced for Nitrogen and Phosphates. Potash was the ingredient not considered of over-riding importance.
2. During the war the figure of profit should have been £20,000 per annum and not £2,000.
3. If calor gas is used for cooking houses before emptying, a great deal has to be used to get an overall temperature of 140 deg. F.
4. If the farm has to have a break in production to stop site contamination then there must be a break of four weeks with no mycelium on the farm.

R. DUTHY

A FIRST CLASS FARM WALK

One day at the end of June, I was discussing with our Public Relations consultants plans for a Press visit to a mushroom farm. We discussed where we should go and whom we should invite and then got down to discussing the organisation of the actual tour of the farm. I gained what I thought was some very good advice, which I fully intended to put into practice. But I found I had been forestalled; the next morning I received a letter from Mr. B. A. King of Willaston, Cheshire, telling me how he had organised a farm walk for the local Women's Institute. It was as if he had worked from the same blueprint as our Public Relations Adviser—every aspect had been dealt with.

Mr. King had prepared for the visit beforehand and had got a stock of publicity material, recipe leaflets and posters for display and distribution. He planned the tour of the farm so that he could manage to do it all himself and, at the same time, make sure that everyone was able to follow it and understand what was going on.

"Monty was placed at strategic points to guide the way to the farm from the house and notices were placed at appropriate points to explain what was going on and what should be observed. At the entrance to the farm was a very brief note on the basic procedure and then on each growing house was a notice to explain what was happening and what to look for. In addition there were notices on all equipment explaining its functions", Mr. King explained.

This pattern enabled Mr. King to concentrate on answering special questions and on doing a little extra publicity, of course! At the end of the tour every visitor received copies of our recipe leaflets and most of them also bought mushrooms.

Mr. King is to be congratulated on his excellent plans and on their successful execution. Now we would like to know how everyone else plans their farm visits. All new ideas will be welcomed.

RO

PRE-PACKS BOUND TO INCREASE

A forecast that increased pre-packaging of all types of vegetables, with the possible establishment of central packaging stations, was inevitable, especially if foreign competition increased, was made by Dr. G. L. Riddell, Chief Scientist of the Reed Paper Group and Vice-President of the Institute of Packaging, when he addressed a one-day conference, organised a short time ago by the Produce Prepackaging Development Association, and held at the London School of Economics. He stressed the need for standardisation with regard to pre-packs, in order to contain costs to the minimum. It might also be necessary to revise the marketing system and to reconsider the profit margins of the grower, the wholesaler and the retailer.

ABSTRACTS FROM RECENT SCIENTIFIC PUBLICATIONS

Mushroom Growing at Popesti—Leordeni State Farm (*Cultura ciupercilor ba G. A. S. Popesti—Leordeni, Bucuresti*). Al. Popescu, 1960, Gradina, Via si Livada 2, p. 10-16, with English, French, German and Russian summaries.

Mushrooms have been grown experimentally underground at this farm near Bucharest since the autumn of 1958.

Local horse manure was obtained in three differing batches which were thoroughly mixed. Gypsum (5—6%), superphosphate (2—3%), and ammonium sulphate (8%) were added. Composting lasted 21 to 26 days, during which time the stacks were turned four times thus avoiding temperatures in excess of 70° C. (158° F.), excessive drying and abnormal losses of ammonia.

The compost was made into ridge beds and spawn, type F-6 from the Hungarian Peoples' Republic, was planted in four rows, two on each side of the ridge with 25 cm. (10 in.) between each piece of spawn. About 2—300 g. ($\frac{1}{2}$—$\frac{3}{4}$lb.) of spawn was used per sq. m. (10 sq. ft.). The temperature at spawning was 30° C. (86° F.).

The beds were cased with a layer of well mixed sand (75%) and clay loam soil (25%) which had been treated with 2% formalin.

During cropping the temperature and humidity were controlled, and Nicotox and formalin were used against pests and diseases.

The first picking was made after 50—70 days according to the temperature, and yields ranged from 2.5 Kg./sq./m. (about $\frac{1}{2}$ lb. sq. ft.) at low temperatures, about 10—12° C. (50—55° F.), to 11 Kg./sq./m. (about 2.4 lb. sq. ft.) at 18° C. (65° F.).

Increasing glasshouse and hot bed productivity by mushroom growing (Valorificarea rationala a serelor prin cultivarea lor cu ciuperci). *St. Partenie, 1959, Gradina, Via si Livada, 8, p.* 10—16, illustrated, with summaries in English, French, German and Russian.

The growing of mushrooms in glasshouses and hotbeds is described, based on experience on a farm near Bucharest. Mushrooms were grown in glasshouses from the autumn until January when tomatoes and cucumbers were planted. Yields of up to 8.6 Kg. per sq. m. (1.9 lb. sq. ft.) were obtained, and mushrooms were more profitable than an autumn tomato crop. Heated Dutch frames can also be used for growing mushrooms both in the spring, when seedling production is completed, and in the autumn.

The locus of aroma in the mushroom (Agaricus campestris L.) Richard A. Bernhard & Marion J. Simone, *Dept. of Food Technology, University of California, Davis, California*, 1959, *Food Research* 24, *p.* 165-6.

Mushrooms, grown commercially in the Davis area, were harvested when the veil had begun to break. They were divided into five groups, cap, stipe, gills, cap cuticle and stipe cuticle. These parts were finely chopped, and 2g. of each placed in containers and tested for the most pronounced mushroom odour. Similar tests were made with mushrooms that had been cooked for ten minutes.

The authors conclude that the central part of the cap and stipe had the greatest mushroom aroma. The gills and skin of the cap and stem had less aroma.

There was no statistical difference between stipe and cap either raw or cooked. PBF

YARMOUTH CONFERENCE/EXHIBITION

16th-17th-18th October

Judging by the readiness with which all the available accommodation has been taken up at The Carlton Hotel, MGA headquarters for this year's conference and exhibition at Yarmouth, there will be a particularly large attendance of growers coupled with a very full programme.

Four lectures, a film show and a small machinery demonstration coupled with a farm walk, may well stretch organising ability to the limit, bearing in mind that, hitherto, when a conference and exhibition have been held, the programme has included only two lectures in addition to the usual items on the programme such as the exhibition itself, mushroom competitions, reception and dance, etc., and, of course, the outing for the ladies.

Full details regarding Yarmouth are to be sent to all members in due course and ticket applications should be made on the form provided. These tickets will cost 15/- each and will cover all activities including the ladies outing. Members unable to find accommodation at The Carlton may like to try The Royal, which is only three minutes walk away.

PRODUCTION RECORD CARD

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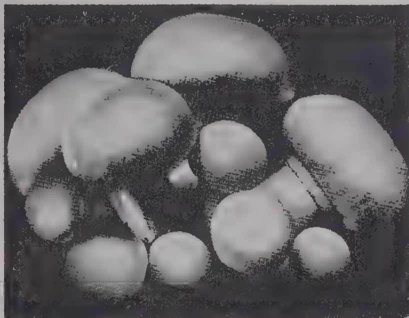

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HOUSE NO. 5 DATE SPAWNED 13th JULY

[CA]SED 23rd JULY 196

	lb.		DAY	lb.	
1	31		32	–	
2	50		33	–	
3	–		34	246	
4	–		35	38	
5	757		36	–	2·80
6	149		37	43	(35
7	388		38	–	
8	–	·83 lb/sq/ft	39	–	
9	224	(7 days)	40	–	
10	–		41	150	
11	–		42	144	
12	–				3·00 lb/sq/ft
13	1158				(42 days)
14	493				
15	–	1·95 lb/sq/ft			
16	281	(14 days)			
17	–				
18	–				
19	122				
20	36				
21	81				
22	144	2·27 lb/sq/ft			
23	45	(21 days)			
24	–				
25	–				
26	–				
27	249				
28	–				
29	–	2·53 lb/sq/ft			
30	169	(28 days)			
31	–				

[S]PAWN: DARLINGTON'S GRAIN

IRISH PEA[T]

TOTAL PICK: 4998 lb

AREA: 1660 sq ft on trays

YIELD: 3·00 lb/sq/ft

COMPARATIVE CROPPING EXPERIMENTS BETWEEN TOP-SPAWNING, THROUGH MIXED SPAWNING, SHAKE-UP SPAWNING AND SUPER-SPAWNING

C. Riber Rasmussen

Director, Mushroom Research Station, Copenhagen

Within the last few years the method of carrying out spawning has obviously had a distinct effect on cropping yield. At the Danish Mushroom Research Station two successive experiments were carried out in 1960 in order to determine the difference in effect between the following four spawning methods :

A. Top-Spawning :

This is the traditional method normally used. The amount of spawn applied is either planted, e.g. 8×8 inches (manure spawn) or distributed at the surface and then lightly ruffled down 1-2 inches (grain, shredded manure or manupels spawn). After three weeks of spawn run the beds or trays are normally full-grown and are then cased. The first mushrooms can be picked 36-38 days after spawning.

B. Through/Mixed Spawning (1) :

After pasteurization the compost is taken out from trays or shelves and thoroughly mixed with the spawn (often carried out by means of specially constructed machines). The compost is often full-grown in 11-14 days, depending on the amount of spawn used, and is then cased. The first mushrooms can be picked 20-26 days after spawning.

C. Shake-Up Spawning (2) :

Normal top-spawning is first applied and after 10-20 days, when the compost is from $\frac{1}{3}$-$\frac{2}{3}$ full grown, the trays and shelves are tipped out and thoroughly mixed and again packed. At the same time they are cased. The first mushrooms may be ready for picking 30-32 days after first spawning.

D. Super-Spawning (3) :

Each week $\frac{1}{3}$ of the pasteurized compost is through/mixed spawned (preferably in trays). After two weeks the compost is completely full-grown and each tray is mixed with two new pasteurized trays and again packed and cased. The first mushrooms can usually be picked 19-21 days after super-spawning. This means that $\frac{2}{3}$ of the pasteurized compost produces the first mushrooms in that time.

The experiment was carried out with a 16 day compost with addition of the Danish Mushroom Research Station's standard chemicals (Normal + 75%) which are: 7 kilos of sulphate of ammonia added at stacking, 26 kilos of calcium carbonate added at the first turn. A mixture of 26 kilos of dehydrated gypsum (plaster) and 7 kilos of superphosphate are added at the second turning. The composting was carried out so as to lead to an *inactive compost* with the following turning schedule : −1, 0, 6, 10, 13, 15 and 16. Which means that the fresh manure (stored

for 5-8 days) was prewatered at day minus 1 (the day before original stacking). First turn was carried out at day 6 (6 days after stacking). The 2nd turn was made at day 10. The 3rd turn was carried out at day 13, but the compost was not stacked after this turn—it was placed in a layer about 20 inches thick. This means that the temperature between this 3rd turn and the normal shake-up-turn (at day 15) only reaches about 120-130°F, thus forming firefang all through the compost layer. The shake-up was carried out in a normal way and again placed in a layer about 20 inches thick and then the next day, on day 16, packed.

The purpose of this composting technique is to finish with a compost which at least once—namely at the 3rd turn—has produced firefang all through the compost and thus released all ammonia. This type of compost is referred to as a " dead " or inactive compost, which is not able to ferment during the peak-heating or at least not very willing to do so. Therefore the peak-heating was carried out as a kind of true pasteurization without taking any notice of air supply during the period. A normal 16 day compost or especially a short horse manure compost depends on sufficient air during this period in order to finish up with a compost completely free of ammonia.

The experiment was carried out both in trays and on shelves with *27 cm. beds*—corresponding to about *120 kilos of finished compost per sq. metre* (moisture 72%) and in 18 cm. beds (20 cm. trays)—corresponding to *80 kilos of finished compost per sq. metre.* The thick beds were laid down with about *9.1 sq. metres per ton of fresh manure* and the *18 cm. beds correspond to about 13.7 sq. metres per ton.*

The spawn used was *Sobexas 84 manupels* and the amount corresponds to *100 grammes per 80 kilos of compost.*

TABLE 1

Cropping yield : kilos per sq. metre (stalks included but soil carefully removed).
80 kilos finished compost per sq. metre (18 cm. layer-trays)
Mushroom Strain : Sobexas 84—100 g manupels per sq. metre.
(16 days N–75% Compost)

	Top spawning Control	Mixed or through-spawning	Shake-up Spawning after 8 days spawn run	Shake-up Spawning after 12 days spawn run	Shake-up Spawning after 16 days spawn run	Shake-up Spawning after 20 days spawn run
Experiment 1						
First 28 days	10.6	17.5	16.6	15.5	16.4	15.7
Next 28 days	4.4	3.4	3.6	3.6	3.6	4.0
Last 34 days	5.1	3.9	3.2	3.4	3.6	4.0
Total 90 days	20.1	24.8	23.4	22.5	23.6	23.7
Experiment 2						
First 28 days	12.4	17.4	15.3	15.2	15.2	14.7
Next 28 days	4.7	4.9	4.7	5.1	4.3	4.6
Last 26 days	2.9	2.2	1.8	1.5	1.1	1.5
Total 82 days	20.0	24.5	21.8	21.8	20.6	20.8

TABLE 1 shows the results obtained with 20 cm. trays (18 cm. compost layer—80 kilos per sq. metre) in which top-spawning and through/mixed spawning were compared with shake-up spawning after 8, 12, 16 and 20 days of spawn run. In earlier experiments it has often been found that shake-up spawning increases the yield very much in the first 28 days—which was also the case in this experiment. There is, however, not much difference between the 4 shake-up treatments. The highest yield was obtained with the through/mixed spawning, not only in the first 28 days, but also in the total picking period (90 days), thus giving a very big increase compared with the control (top-spawning), —this is also higher than in any of the shake-up treatments—especially in the 2nd experiment.

It is very interesting to realise that the big advantage with shake-up spawning is always seen when working with thick beds (27 cm.-36 cm. corresponding to 120 and 160 kilos of compost per sq. metre), whereas hardly any increase was found with thin beds, 10-15 cm. (40-60 kilos of compost per sq. metre).

This has been found in several experiments. TABLE 2 shows the results obtained in such experiments.

TABLE 2

Cropping Yields : kilo per sq. metre (stalks included but soil carefully removed).
Mushroom Strain : Sobexas 84
Cased 21 days after original spawning.

	160 kilos of compost per sq. metre—36 cm. bed. 6.8 metres per ton of fresh manure. 200 g spawn per sq. metre.		*120 kilos of compost per sq. metre—27 cm. bed. 9.1 sq. metre per ton of fresh manure. 150 g spawn per sq. metre.*		*80 kilos of compost per sq. metre—18 cm. bed. 13.7 sq. metre per ton of fresh manure. 100 g spawn per sq. metre.*	
	Without shake-up spawning	*Shake-up spawning after 19 days*	*Without shake-up spawning*	*Shake-up spawning after 19 days*	*Without shake-up spawning*	*Shake-up spawning after 19 days*
First 28 days	12.2	23.6	13.7	24.0	10.3	13.8
Next 28 days	6.5	8.5	7.9	5.2	5.6	4.0
Last 26 days	2.9	2.6	2.7	1.9	1.6	1.2
Total 82 days	21.6	34.7	24.3	31.1	17.5	19.0

It will be seen that with shake-up spawning a very heavy increase in yield was obtained in the first picking period (28 days), especially with the deep beds, whereas the 18 cm. beds only produced a comparatively small increase. This is in accordance with what has been found several times before.

Looking at the figures after 90 days picking there is also a very big increase for the shake-up treatment in the very deep beds and only a comparatively modest increase in the 18 cm. beds.

The experiment was carried out in the following way :

All the compost used was peak-heated (pasteurized) in a 30 cm. layer (120 kilos of compost per sq. metre) and after the pasteurization—but before spawning—the different plot depths were made up. This means that all compost was taken out –shaken-up—and then packed in the depth mentioned. Then the beds were top-spawned.

After 19 days of spawn run the treated plots were shaken up and the control plots were laid untouched. This should be noted because it proves that the increase in yield does not lie in the shake-up as a physical effect, because all treatments were shaken up at the repacking before spawning.

The table shows a very interesting thing with regard to yield and amount of compost used. With shake-up spawning it is possible to utilize the compost so as to get a yield proportional to the amount of compost used.

Looking at the final figures after 82 days of picking in the experiment with 18 cm. beds (80 kilos of compost per sq. metre) and without shake-up spawning, 17.5 kilos of mushrooms are produced per sq. metre. By increasing the bed depths to 27 cm. (120 kilos of compost per sq. metre) one would expect a 50% higher yield, namely 17.5 kilos + 50% = 26.2 kilos per sq. metre. But this is not the case with the treatment without shake-up—only 24.3 kilos were produced. But with shake-up spawning the yield rose to 31.1 kilos. In fact, if we regard the expected yield of 26.2 kilos as a 100% utilisation, the 31.2 kilos produced close to 122%. This is, in other words, much more than a proportional yield and is apparently due to the shake-up spawning and nothing else.

The 36 cm. treatment (160 kilos of compost per sq. metre) should have produced 35.0 kilos per sq. metre compared with the 18 cm. depth (80 kilos of compost per sq. metre), but only produced 21.6 kilos in the treatment without shake-up. When shake-up was given the yield increased to 34.7 kilos or very nearly proportional to the amount of compost used. This is very interesting and very important from an economic point of view. To increase the beds from 8 inches to 11 inches would obviously not increase the yield when the traditional spawning method is applied—at least not within a reasonable length of picking time, but with shake-up spawning it would. It would take too much time here to explain a possible reason for that phenomenon, but it must have a good deal to do with the total surface of hyphae in the compost, which certainly are increased very much by applying shake-up spawning.

Growers working with, say, 8 inch beds or trays could in most cases in the same house increase bed depth to, say, 11 inches and still have the same surface. It is clear that the air/bed ratio decreases, but according to the latest air experiments (especially in connection with an effective

recirculation-equipment) it will not affect the yield. This means that apart from the 50% extra expense on manure and extra labour for composting and a bit more for packing etc., most other expenses (peak-heating, casing, daily routine work) are the same. One very important factor is, of course, saving in growing room space.

According to the experiment it is also evident—at least with the 11 inch beds—that the proportionality is just as good in the first month, which means that the number of crops laid down per year does not need to be reduced. It must, however, be stressed that the type of strain used (Sobexas 84) is a very fast producing type, and other results may be expected when a slow producing strain is used. Experiments on these lines are at the moment in progress.

TABLE 3

Cropping Yields : kilos per sq. metre

(stalks included but soil carefully removed)

120 kilos finished compost per sq. metre (27 cm. layer shelves)

Mushroom Strain : Sobexas 84—154 g manupels per sq. metre.

	Top spawning control	Mixed or through spawning	Shake-up Spawning after 19 days spawn run	Super-Spawning carried out 13 days after first through-spawning
Experiment 1				
First 28 days	14.4	18.8	21.7	25.0
Next 28 days	8.3	8.6	8.4	8.1
Last 34 days	9.0	8.3	7.8	6.3
Total 90 days	31.7	35.7	37.9	39.4
Experiment 2				
First 28 days	16.0	22.7	23.7	24.1
Next 28 days	11.1	8.4	11.4	11.2
Last 26 days	1.8	2.1	1.8	2.0
Total 82 days	28.9	33.2	36.9	37.3

As mentioned earlier two successive comparative cropping experiments were compared with the four spawning methods described. The results are shown in TABLE 3. The experiment was carried out with 11 inch beds (120 kilos of finished compost per sq. metre) and with 150 grammes Sobexas 84 per sq. metre. It is obvious that in both experiments the lowest yield came from the control (top-spawning) with a steady increase in yield from through/mixed spawning to shake-up spawning and superspawning. This is the case both in the first 28 picking days and in the total picking period of 90 and 82 picking days respectively.

In the first experiment the difference between the top spawning and the superspawning treatment amounts to 7.7 kilos per sq. metre and in the second experiment to 8.4 kilos per sq. metre—which must be considered a big increase.

It must be noted that in the second experiment the yield obtained in the 3rd picking period (26 days) was much lower than in the last picking period (34 days) in the first experiment. This is without doubt due to a suddenly appearing degeneration phenomenon which stopped production. Normally picking is also very good in the last picking period (34 days).

Generally the yield is very high. The yield is of closed mushrooms with stalks included, but soil very carefully removed. Tests have been made in which 1-2 cm. stalks have been cut off, which leaves 12-13% to be subtracted in order to compare with countries where mushrooms for fresh market are trimmed. The highest yield obtained (with super-spawning in the first experiment), namely 39.4 kilos per sq metre minus 12% for stalks leaves 34.7 kilos per sq. metre or 315 kilos trimmed mushrooms per ton of manure at the day of delivery. The yield per ton is indeed extremely high. It must, however, be mentioned that such figures are rather easy to obtain with a short composted horse manure (7 days) e.g. 8-20 cm. trays or shelves, giving 33-34 sq. metre per ton. At 9-10 kilos per sq. metre the same yield per ton is obtained.

That technique involves considerably higher costs (trays, spawn, casing, heat, rooms, picking, etc.,) and therefore gives a higher production cost per kilo than with the super-spawning method mentioned. The remarkable thing is, that with super or shake-up spawning and also with through/mixed spawning much thicker beds can be used, giving the same high yield not only per sq. metre bed area, but also per ton of fresh manure.

Discussion

Care must be taken in order to obtain the very best results with these new spawning methods, especially with shake-up and super-spawning.

The outside composting must be carried out so as to leave a completely inactive compost –thus being able to carry out peak-heat without air, which again means that a true pasteurization (without any fermentation) is essential.

Originally, it was thought that the super-spawning method could save a considerable amount of orginal spawn. This seems not to be the case. It is important that the spawn trays (named " virgin " trays) are completely fullgrown when they are used for super-spawning the newly pasteurized compost.

The super spawning method has now been tried on a commercial scale for about two years and the experiment shows that although it sometimes seems sufficient with a reduced amount of spawn too many failures happen. Using the normal amount of spawn and preferably increasing it in the " virgin " trays really acts as a safeguard. It is important that a compost which is not quite up to standard becomes full grown as soon as possible, which is likely to happen with more spawn. Growers must also be warned against using even completely fullgrown "virgin" trays to spawn too many newly pasteurized trays.

In several cases it has been seen that using for instance, one " virgin " tray to 5-10 " compost trays " resulted in very bad yields. It must be emphasised that using "virgin" trays which have been slow in growing and therefore are not fullgrown within the 14 days schedule should be avoided. "Virgin" trays in which *Stysanus stemonitis*, *Chaetomium* etc., are seen *should not* be used even if they are completely fullgrown at the time of using them. To give a detailed explanation here will take too much space, but in the experience gained within the past two years on a commercial scale such trays have resulted in a complete failure, with the mushroom spawn disappearing very fast.

It must, however, be mentioned that it is very seldom that new infestation takes place at the time of shake-up or super-spawning—the real danger is " born " during the pasteurization phase. When a pasteurization is carried out as to leave what could be named "*Chaetomium*-condition " by which is meant where *Chaetomium*, *Stysanus stemonitis*, "white" or "brown" plaster-mould etc. are likely to appear, although one does not need to see moulds, it always results in bad spawn run. It is quite clear therefore that in most cases (apart from the well known types as *Myceliophthora* etc.,) the different " moulds " which are seen in a compost are not due to infestation—they are always in the compost, but one sees them only when one creates conditions for them (during peak-heat or pasteurization).

In most cases, where slow spawn-run is noticed, it is due to such " *Chaetomium*-conditions ". It must be stressed that one does not always need to recognise the moulds with the naked eye. The amounts depends on how good conditions have been created for them. The main thing is that if at the time of super or shake-up spawning even a very little *Chaetomium* or *Stysanus* is present in the " virgin " trays it leads to a bad result. The simple reason for this is obviously, that the mycelium of the foreign moulds—especially in connection with too low temperature after super or shake-up spawning, or too high temperatures as explained later—tries to occupy the compost before the mushroom mycelium is able to anastomose and the latter therefore has no chance to re-establish itself. The "virgin" trays must be healthy and with a fast and vigorous spawn-run to take place immediately after spawning, as a guarantee that no inhibiting effects (*Chaetomium*-conditions) are produced during the pasteurization.

It is not always a question of the spawn's own vitality or activity. A certain spawn strain gives, in the same compost, a certain speed of moving, whereas one spawn carton planted in 10 different composts varies very much. This proves that it is more the compost-conditions which make the difference in spawn-growth than the spawn strain itself. Of course exceptions can be seen where the spawn is faulty, but then often in connection with degeneration problems. It is also true that differences occur when grain or manure spawn is used. A compost with traces of ammonia reduces the spawn growth more when grain is used than with manure spawn—at least at the start. The single grains have not much resistance to traces of ammonia.

It has often been proved that with badly prepared composts the yields between strains vary greatly, whereas the variation is much less with a good compost (this applies at least with normal top-spawning). It is not wrong to state, that each strain really needs a certain type of compost in order to produce maximum yield. It is only fair to speak about the tolerance of certain strains. Strains may be very tolerant and produce a fair yield even with badly prepared compost (included pasteurization). It is not always certain that a tolerant strain then is likely to produce a much higher yield with a so-called well prepared compost. In such a case it is obviously a spawn problem, but on the other hand it is also possible that an optimum growing method has *not* been created, because we don't know what this particular strain needs in order to compete (in yield) with other strains, which perhaps *like* the type of compost and conditions we prepare. Whether the spawn-maker should prepare strains which suit the type of compost we make or the growers should prepare a compost which suits the strain the spawn-maker produces is a problem. But until more is known a compromise is likely to be the solution.

In some experiments carried out recently at D.M.R.S. it has been shown that a compost can be made *too* well and with a very good and vigorous spawn-growth, but in spite of that the mycelium refuses to produce fruit-bodies probably because the mycelium wishes to stay in the vegetative stage. The reason may be explained in a too high CO_2 production in the compost, but the problem seems without doubt related to the strain characteristics. Slow-producing ones are more likely to stay in the vegetative stage. That is the reason for the slow production in the first part of the picking period, which is gradually improved with longer picking periods. A quantitative CO_2 determination might give the answer.

The fruiting problem is to some extent very little understood. Many theories have been expounded. The author has been working on the theory that in the vegetative stages the " stream " or transport in the mycelium cells goes one way and when the mycelium has finished this vegetative stage the " stream " is turned in order to transport the " building material " to the fruit bodies. A slow-producing strain turns the " stream " gradually, depending on the chances for more vegetative growth, the fast producing strain finishes the vegetative growth sooner and the " stream " is turned in most of the hyphae, and fruiting starts very fast. The slow-producing strains are often very vigorous in spawn run and when one creates conditions for introducing maximum mycelium in the compost, it often takes too long a time to get the "stream" to turn e.g. to get the mycelium to fruit. First, when all vegetative growth has been stopped in one way or another—obviously because there is no more chance of vegetative growth (all is fullgrown)—then the fruiting starts normally.

It is well known that spawn may run right to the top of the casing and produce " overlay " followed by very bad or no fructification the mycelium remains in its vegetative stage. Research on these lines is at the moment in progress, using isotopes.

It has been thought that the fructification depended on a kind of " microlife ". The author has proved that with a simple partial sterilization (90°-100°) of casing-material (soil) very little or no fructification appeared, whereas the non-sterilized casing produced normal mushrooms. Dr. Tschierpe thinks that the fruiting depends on the CO_2 gradient through the casing-layer. Both theories are probably right : they are apparently very much connected. It is evident that it is important to "wake up" the vegetative spawn growth so as to reach a stage in which the fructification starts.

The author has shown that a bed spawned with a slow producing, strain can stay in its fructification stage for a long time, only producing very few sphorophores (if it is super-spawned with very little original mycelium-27 cm. bed) and if, at the same time, it has a temperature of 24° C. over a long time (2-3 weeks). In such a case the vegetative growth is very vigorous. The spawn " forgets " to change from the vegetative to the fructification stage on its way through the casing. The casing acts as compost and the fructification is much reduced although everything seems perfectly normal. Later on, the fruiting gradually becomes better and better, when there is no more chance of vegetative growth in compost and maybe in the casing material.

The phenomenon called mass-pinheading must also to some extent be considered as a difficulty in normal fructification. The many pinheads remain in a dormant stage without maturing and without dying off. This has often surpised mushroom growers, but as one does not expect spawn to die in the compost because no fructification takes place, why should the tiny pinheads die? Until the pinheads reach a certain stage they are much like normal vegetative mycelium (cells).

In order to return to the spawning experiments mentioned, a few more problems connected with the spawning method should be discussed, apart from what is generally known when normal top-spawning is used. It has been said that with through/mixed spawning (especially when grain spawn is used) the compost must definitely be free from ammonia. The shake-up and super-spawning needs, furthermore, as already explained, a compost which is absolutely free from " *Chaetomium*-conditions ", because this often develops different " moulds " which are propagated extremely fast after super or shake-up spawning has been carried out. A very important thing is the temperature rise after shake-up or super-spawning. When shake-up spawning is applied (and $\frac{2}{3}$ are full grown) this really is the same as super-spawning, but here the ratio is two parts full grown compost to one part without mycelium. With the super-spawning method the ratio is $\frac{1}{3}$ full grown and $\frac{2}{3}$ new-pasteurized compost (1 tray to 2 trays). In both cases a very great activity takes place and, 4-7 days after, a marked temperature rise is often observed. This is especially true with thick beds.

When no foreign moulds are present the temperature may rise as high as 31-32°C. *without danger*, but it is always wise to drop the air temperature as soon as possible (to 16-17°C). The energy produced in the beds must have a chance to escape, otherwise the temperature in the beds rises even higher and the spawn is killed. It is therefore

understandable that to put trays on the top of each other without cornerposts makes things worse. Practical experience has shown that 6-7 cm. gaps between the trays are important, but even that is not enough if the outside temperature in summertime rises over 20°C or more. Therefore, when thick beds are used and with super or shake-up spawning it is safer to work with a cooling system so as to be able always to drop the air temperature enough to keep the compost below 29-30°C. It should be mentioned that after the shake-up or super-spawning the temperature has to be kept at the normal 24°C. Only when the temperature in the compost rises is the cooling switched on.

If " virgin " trays contain only very little foreign mould, then it it is clear that the temperature rise due to the activity of the mushroom mycelium at the same time creates better conditions for eventual competitive moulds. Which wins the race depends on (1) the amount of vigorous mushroom mycelium or (2) the amount of foreign moulds. But it must be stressed that even a little foreign mould is dangerous, because the temperature helps their growth. When much foreign mould is present the temperature also rises because of the activity of the mould's regeneration, and gives the mushroom spawn even less chance to establish.

It is however also true to say that when shake-up or super-spawning is used and the compost falls too much in temperature (because of the " operation "), it has been seen that the mushroom mycelium will not grow together (anastomose) and very soon after—especially when moulds are present—the mushroom mycelium disappears. Therefore the temperature must in all cases be brought to 24°C as soon as possible after super or shake-up spawning.

Mushroom growers who have not been able to prepare a compost (and carry through a peak-heating) in which the spawn starts to grow immediately after spawning and therefore is fully grown in the compost in 11-13 days, *should not* adopt this new system. Such growers should try to create good conditions as quickly as possible, because this in all cases increases the yield.

The problems concerning temperature rise after super or shake-up spawning are increased with deeper beds. It has also been proved that pasteurization in deep trays often causes problems. Therefore, it is advisable to carry out peak-heat in a normal tray depth (18-20 cm.). After pasteurization $\frac{1}{3}$ is through/mixed spawned and placed in the " virgin " room and the $\frac{2}{3}$ are super-spawned with the " virgin " trays (at that time two weeks old) and then packed into bigger and deeper trays. Such big trays are made with strong legs so as to leave a distance between the trays for picking and daily routine work (30-35 cm.). When these trays are stacked on the top of each other they can be used as a kind of " shelf-sections " which can be moved around by means of a truck. Work by hand is reduced to only stacking the empty trays at time of filling (after super-spawning) and at the emptying procedure, and this is quite simple to mechanise so as to avoid all hand work.

On shelf-farms, where the super-spawning system is adopted, one special room is converted into a peak-heating room, where the compost

is placed on shelves (rather thick beds) and pasteurized without air (16 days inactive compost). At spawning time $\frac{1}{3}$ of the compost is through/mixed spawned, packed into trays and moved to a special spawn-running room. The rest is super-spawned and packed in shelf-houses as usual.

One of the advantages with the super-spawning (in which the compost is fully grown after 3-4 days) is that casing takes place immediately after super-spawning. There is no need to wait.

General Comments:

In a number of experiments carried out at the Danish Mushroom Research Station it has been proved that in order to carry out a 16 days composting with addition of the N – 75% inorganic chemicals, it is important to use a composting shed in which all draught is excluded. The important thing is to finish up with a *completely inactive compost* (free of ammonia) and this cannot be made without cover or in an open shed. The essential thing with the *inactive-composting-process* is that all " nutrition " is prepared during the outside composting, during which a wide range of micro-organisms, working at many different temperature levels, decompose the material into a suitable mushroom substrate. It is essential that the composting process is carried out *very very carefully* and requires quite a lot of time (man-hours).

Unlike short-time-composted horse manure, it does not seem necessary to add organic nitrogen supplements. The presence of free ammonia at filling is directly damaging. In most trials carried out at the D.M.R.S. a considerable decrease in yield (more than 40%) has been recorded with 7 day horse manure compost, compared with the 16 days inactive compost. The actual yield with the short-time composted manure was quite high, showing that no mistakes were made in the technique. The yield from the 16 days compost was, however, much higher.

It is true that the *inactive composting process* needs much space in the composting shed, because it is essential that the compost at the 3rd turn and at shake-up is spread out in a 20 inch layer. It is also true that the composting process requires more days, but if the number of turns is compared with *the 7 days composting process* it is really not much extra work. The 16 day compost requires one pre-watering and one stacking, two turns, two shake-ups and one packing. This means that the manure is handled seven times. With the seven day method, two pre-waterings are often required, and together with one stacking and two turns and packing, the manure is handled six times.

It has often been argued that the 7 day compost produces more sq. metres bed area per ton, which is right—it does however depend on the amount of compost (in weight) used per sq. metre. It must certainly be an advantage to bring the volume of the compost down, so that more " nutrition " per sq. metre (in volume) is laid down.

According to several experiments at D.M.R.S., in which it has been seen that the yield (by applying the new spawning method) is almost proportional to the amount of compost used (up to 11 inch layer),

Table 4

Comparative Experiments between
16 days inactive compost + N + 75%
and
7 days short-time compost + 14 kilos gypsum

Cropping yield : kilos per sq. metre
(stalks included but soil carefully removed).

80 kilos finished compost per sq. metre (18 cm. layer trays).
Mushroom Strain : Sobexas 84—100 g manupels per sq. metre.

	Top spawning Control	Mixed or through-spawning	Shake-up Spawning after 8 days spawn run	Shake-up Spawning after 12 days spawn run	Shake-up Spawning after 16 days spawn run	Shake-up Spawning after 20 days spawn run
Experiment 1. 16 days (N+75%)						
First 28 days	10.6	17.5	16.6	15.5	16.4	15.7
Next 28 days	4.4	3.4	3.6	3.6	3.6	4.0
Last 34 days	5.1	3.9	3.2	3.4	3.6	4.0
Total 90 days	20.1	24.8	23.4	22.5	23.6	23.7
Experiment 1. 7 days (14 kilos gypsum)						
First 28 days	6.9	9.3	10.4	7.2	9.2	8.8
Next 28 days	3.5	3.8	3.1	3.7	3.2	2.8
Last 34 days	2.5	2.6	2.7	2.3	2.1	2.3
Total 90 days	12.9	15.7	16.2	13.2	14.5	13.9
Experiment 2. 16 days (N+75%)						
First 28 days	12.4	17.4	15.3	15.2	15.2	14.7
Next 28 days	4.7	4.9	4.7	5.1	4.3	4.6
Last 26 days	2.9	2.2	1.8	1.5	1.1	1.5
Total 82 days	20.0	24.5	21.8	21.8	20.6	20.8
Experiment 2. 7 days (14 kilos gypsum)						
First 28 days	10.2	10.6	10.9	9.1	10.5	11.7
Next 28 days	4.1	3.7	3.1	3.7	4.1	2.9
Last 26 days	2.0	1.7	1.0	0.6	0.7	1.0
Total 82 days	16.3	16.0	15.0	13.4	15.3	15.6

Table 4 shows results from such experiments in which top spawning, through/mixed spawning and shake-up spawning at four intervals were tried. Only 18 cm. compost was used—20 cm. trays (80 kilos of finished compost per sq. metre).

there is no longer any excuse for working with shallow beds. It must then be important to put as much "nutrition" in the trays or shelves per unit as possible, thus reducing the general costs. A 20 cm. bed does not cost more in heating, casing, watering etc., than a thin bed, (10 cm.) and the thin beds require much more space per ton of compost.

In past years it has often been stated that a high nitrogen content in the fresh manure is important in order to obtain a reasonable yield. This is probably right when the short-time composting technique is applied, and without doubt necessary in order to make a compost to produce a reasonable cropping yield.

In many countries however, such supplements are very expensive—at least in Denmark. The cost of application of the Normal +75% chemicals is very small and the materials are constant in quality. The highest yield probably ever recorded in the world has recently (January-February 1961) been obtained at the D.M.R.S. with a 16 days *inactive compost* (N+75%), 27 cm. beds (126 kilos of finished compost per sq. metre) and with through/mixed spawning applied. In the first 21 picking days the fantastic yield of 30.08 kilos of mushrooms (stalks included but soil carefully removed) per sq. metre was obtained, corresponding to 246 kilos mushrooms per ton of fresh material. In 56 picking days the yield reached 40.56 kilos per sq. metre or 333 kilos per metric ton of fresh material (8.2 sq. metres finished compost per metric ton of fresh manure the day of delivery).

One of the very interesting things was that the nitrogen content on the day of delivery (directly from the stable) was an average 1.25%N of the dry weight—the moisture content average 55.8%. According to Dr. J. W. Sinden and collaborators (4) it is important that the nitrogen content should not go below 1.50% and preferably between 1.5 to 2.0% (obtained by addition of extra organic nitrogen). It has therefore been proved that by applying a careful 16 days outside *inactive composting process* with only inorganic chemicals (N+75%) leads to a better result.

According to some experiments carried out at the D.M.R.S. it has been proved that by using the *inactive composting process* the compost can be pasteurized satisfactorily without air at all. The compost in these experiments was packed in trays lined with polyethylene film in such a way that the trays were airtight.

It is now common practice on most commercial farms in Denmark and also in some abroad to make this kind of compost and without introducing fresh air during the pasteurization.

In the present experiment at the D.M.R.S., in which these very high yields were obtained, the *inactive compost* never received any air during the pasteurization—except what was introduced when doors were opened (a few seconds) in order to check temperatures, which was done every hour.

Previously it has cost much fuel in order to maintain peak-heating temperatures in the normal way by introducing fresh air. Now, however, the fuel bill is reduced to a minimum.

SUMMARY

1. The normal way of carrying out spawning (called top spawning) has in two experiments showed a considerably lower yield compared with through/mixed spawning, shake-up spawning and super-spawning, with the last method producing the highest yields.
2. The new spawning method is more likely to give yields proportional to the amount of compost used than is the normal top-spawning.
3. In applying the shake-up and super-spawning method it is highly important that no " *Chaetomium*-conditons " are produced during the pasteurizing process. This often leads to establishment of foreign moulds, thus retarding the spawn growth.
4. Precautions must be taken in order to avoid extreme temperature rise in the compost after shake-up or super-spawning. The problem is accentuated by increased bed depth. By reducing air temperature to about 16°C (as soon as temperature rise is observed in the compost) the danger is prevented. By doing this the temperature in the compost usually does not exceed 29-30°C with 26-28 cm. depth and with 30-40 cm. air between the shelves or trays. At this temperature the mycelium continues normal growth.
5. The *inactive composting process* (N+75%) does not apparently need extra organic nitrogen added in order to produce high yields. 1.25%N of the dry weight is sufficient. A well prepared *inactive compost* does not need any fresh air supply during the pasteurization process.

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